

Reply to Reviewer 2

We kindly thank the reviewer for the helpful advice and constructive comments on our manuscript. Please see below for point-by-point responses. Comments are quoted in *italics*, and our responses are interleaved in regular font.

This is a well-structured and substantial manuscript. Through a highly comprehensive framework, the author compared six drought cases across Germany and China's Beijing-Tianjin-Hebei region, spanning agricultural, industrial, and modern eras. The integration of multi-source data and establishment of a unified analytical framework are two key achievements of this work. They made the comparative analysis reasonable and conclusions credible. The revelation of unchanging nature of drought holds significant value for understanding and better addressing drought challenges.

Response: We appreciate your positive comments on our study and suggestions on how to improve this manuscript.

Some suggestion:

(1) What is the orange boundary in Figure 1(b)? It seems not right if it represents the boundary of the North China Plain.

Response: Sorry for the mistake. We originally intended to that the Jing-Jin-Ji Region is located in the northern part of North China, a densely populated and drought-prone region of China. We have corrected this mistake in both Figure 1(b) and the main text in the second paragraph of Section 2.

(2) Section 3.3 - I noticed that in the impact categories, water deficit or deterioration involved multiple categories. How to identify them in different materials? Although detailed theoretical classifications are provided, it might be also important to clarify how these categories were recorded, described, or quantified across historical, early modern, and modern source materials.

Response: Manifestations relating to the deficit or deterioration of water include:

- a) Precipitation deficits in the meteorological category. It refers to the lack of precipitation (e.g., rainfall, snow, etc.).
- b) Deteriorated water quality in the sub-category of freshwater system in the ecological category. It refers to the deterioration of water quality in natural or artificial water bodies due to drought and/or heat, such as algae bloom, increased pollutant concentration, and oxygen depletion.
- c) Manifestations of drought affecting rivers, lakes/reservoirs, and groundwater in the hydrological category. They denote reduced streamflow and/or water storage due to low water supply after months of inadequate precipitation.
- d) Manifestations in the sub-category of water security in the socioeconomic category. In term of deficit, it refers to insufficient/limited/no water supply for certain purposes, such as drinking, washing and cleaning, watering and irrigation, industrial production, etc. As for deterioration, it mainly concerned with the quality of drinking water; for example, water provided for drinking during droughts was no longer guaranteed to meet drinkable standards.

An additional list is provided at the end of this document and will be uploaded as a new supplement of this article, which includes keywords for the 55 manifestations in five drought categories, as well as examples of how these manifestations were documented in historical, early modern, and modern source materials. We hope it could provide required details to anyone interested and help the reader to understand our framework.

(3) Section 3.4 - I totally understand that defining the start and end of meteorological-level precipitation deficits is relatively straightforward and. However, as I know, historical textual records often reflect lagged effects of drought impacts. How do the authors view the omission of such lagged information, and to what extent might this affect the conclusions? A brief clarification would be helpful.

Response: Thank you very much for your kind understanding. Our definition of the event duration is actually a tradeoff between the limited availability and relatively narrow scope of drought records in history (e.g., insufficient soil moisture was mentioned only in severe cases like “cracks in land”) and the abundant and comprehensive drought reports at present (e.g., varying degrees of soil moisture at different soil depths). In other words, good documentation of meteorological-level precipitation deficits could be seen as the greatest common denominator of drought narratives across regions and over time.

We acknowledge that two types of lagged information about drought impacts might be missing in the current study due to the event duration we defined, which are as follows:

- i. The first are some cascading effects of drought that take a relatively long time (e.g., more than a year) to develop or be tangible. In order to approximately assess the potential of such omission, we looked again at drought-related descriptions in chronicle and compilation, yearbook, and secondary research (i.e., written documents that were normally composed in the form of after-the-fact summaries) adopted in this study. We found that impacts still reported after sufficient rainfall were more or less a continuation or repetition of previously reported impacts rather than entirely new ones, except for “the harvests of 1922 and 1923 were good, but it was hard to hire agricultural workers because so many had gone to the cities (Li, 2007)” (i.e., potential for affecting crop harvests) shortly after the Jing-Jin-Ji 1920 drought. We believe such omission would not invalidate the main findings of our categorization-based analyses of drought consequences. Nevertheless, we are not saying that these lagged effects are worthless or that such omission hardly raises uncertainties.
- ii. The second are less tangible but far-reaching drought impacts, such as altering social resilience and even accelerating social collapse. This topic is also important for understanding drought challenges, but it somewhat go beyond the focus (or rather capability) of case studies, i.e., to create relatively comprehensive case profiles, analyze single cases in depth, and/or compare a certain issue in different cases.

We fully agree that it is helpful and necessary to make a brief clarification on limitations of this event duration definition. Thus, modification has been made to the second paragraph of section 3.4 as below:

“This study took the onset and cessation of precipitation deficits as the beginning and end of an event, which was a trade-off between the limited availability and relatively narrow scope of drought records in history and the abundant and comprehensive drought reports at present. As sequels to the lack of precipitation, other effects and impacts of drought may not take place (e.g., electricity shortage) or be well documented (e.g., degree of soil moisture at different soil depths) in every region and at every episode of social development. In addition, some impacts can continue in an inconspicuous manner over a non-measurable span after precipitation returned to normal (e.g., reduced coping capacity for future hazards), which goes more or less beyond the scope of the current case study. Nevertheless, it should be noticed that this definition of event duration is not ideal for exploring drought effects in the long run (e.g., post-drought labor shortages due to climate exodus) or drawing a complete picture of drought resilience over a period.”

(4) Figure 6- What are the specific criteria for identifying "heat-related manifestations"

Response: For a given manifestation in the socioeconomic category, whether it was related to heat or not was identified based on specific textual information in written documents. A manifestation was considered heat-related when it was clearly documented as being exacerbated or induced by high temperature. We have added necessary explanations in the caption for Figure 6 as below:

“Heat-related manifestations refer to those clearly described in written documents as being associated with or caused by abnormally hot conditions, such as increasing imbalances in water or electricity supply and demand due to increased consumption in hot weather, heat-related illness and deaths, and heat damage to infrastructure (e.g., railway, road).”

I found that the results and discussion emphasize the focus on concurrent high temperatures during droughts (as reflected in the conclusive title of Section 4.3 and the analytical discussion in Section 5.3). I think that why authors

caring about high temperature would be better explained in the main text rather than being confined to table notes (Table 1).

Response: Many thanks for the advice. We have enriched the explanation of why we should care about concurrent high temperatures during droughts (please see below), and moved it from table notes (Table 1) into the main text in the second paragraph of Section 3.3: “In addition, compound heatwaves were incorporated into the meteorological category, considering not only the contribution of abnormal high temperature to the likelihood and destructiveness of drought (Zscheischler et al., 2018), but also the not rare descriptions in written documents of the combined effects of heat and drought.”

Reference

Zscheischler, J., Westra, S., Van Den Hurk, B. J. J. M., Seneviratne, S. I., Ward, P. J., Pitman, A., AghaKouchak, A., Bresch, D. N., Leonard, M., Wahl, T., and Zhang, X.: Future climate risk from compound events, *Nature Clim Change*, 8, 469–477, <https://doi.org/10.1038/s41558-018-0156-3>, 2018.

(5) The current title seems to emphasize regional differences. I think it may be more clear to explicitly highlight the study's scope and conclusions in the title. For example: Cross-era Case Comparison Between Germany and Jing-Jin-Ji Region (China) reveals Invariance and Changes in Drought Impacts and social Responses.

Response: Many thanks for the advice and example of article title. We agree that it would make the title much clearer if we could point out the scope and main conclusions of this study directly. Now, we are considering changing the title to *Stable yet dynamic: A cross-era comparative case study of drought impacts and societal responses in Germany and Jing-Jin-Ji Region (China)* or a similar expression that can highlight our research focus.

Keywords and description examples of drought manifestations

This supplement provides keywords for describing the 55 manifestations in five drought categories, as well as examples of drought-related descriptions in written documents (excl. secondary research) during different periods. For each drought manifestation, keywords have been translated into English, and description examples remain in the language of the original content. In addition, when a manifestation was not mentioned in a specific drought event or described at the seasonal scale, its example is marked as N/A. The following information aims to show how drought was generally recorded and described in different eras, thus helping the readers to understand the drought categories presented in this study.

1. Meteorological category

1) Sub-category of precipitation

a) Deficit

Keywords: dry conditions, low precipitation

- i. Examples of historical sources materials
 - Germany 1834 event: schöner anhaltend trockener Witterung; bloß trat etwas Regen ein
 - Jing-Jin-Ji 1832 event: 春旱; 虽有小雨, 总未渥霈甘霖
- ii. Examples of early modern sources materials
 - Germany 1921 event: Trockenheit im Frühjahr; geringen Regens
 - Jing-Jin-Ji 1920 event: 早春旱; 入春以来, 风多雨少
- iii. Examples of modern sources materials
 - Germany 2018 event: [der Herbst 2020] warm, sonnig und trocken
 - Jing-Jin-Ji 1997 event: 旱象露头; 入秋以来降雨少

b) Severe deficit

Keywords: severe/extreme/great dry conditions, hardly any/no precipitation for a season or longer

- i. Examples of historical sources materials
 - Germany 1834 event: äusserst trocken; den ganzen Sommer regnete es nicht
 - Jing-Jin-Ji 1832 event: 亢旱; 夏大旱; 经夏不雨
- ii. Examples of early modern sources materials
 - Germany 1921 event: viel zu trocken; [die Trockenheit] hielt fast den ganzen Sommer über an
 - Jing-Jin-Ji 1920 event: 亢旱无雨; 夏令亢旱
- iii. Examples of modern sources materials
 - Germany 2018 event: [der Frühling 2020] außergewöhnliche Trockenheit; noch nie fiel zwischen April und Juli so wenig Regen
 - Jing-Jin-Ji 1997 event: [夏季] 无雨; 有降水量记录以来的最少值

2) Sub-category of heatwave

Keywords: rare/abnormal hot conditions, terrible/extreme/unbearable/record-breaking heat

- i. Examples of historical sources materials
 - Germany 1834 event: der Herbst war so warm, dass alle barfuß liefen; grosse Hitze
 - Jing-Jin-Ji 1832 event: 风日炎燥; 南风如火
- ii. Examples of early modern sources materials
 - Germany 1921 event: Tropenhitze; [die Hitze] einen ungewöhnlichen Umfang angenommen
 - Jing-Jin-Ji 1920 event: 长夏炎炎
- iii. Examples of modern sources materials
 - Germany 2018 event: tropische Nächte; eine neue Hitzewelle mit historischen Temperaturrekorden
 - Jing-Jin-Ji 1997 event: 高温闷热; 酷热; 历史上罕见的持续高温天气

2. Ecological category

1) Sub-category of vegetation

a) Abnormal phenological period

Keywords: unusual flowering, advanced growth, early harvest, early discoloration and defoliation

- i. Examples of historical sources materials

- Germany 1834 event: Ernten wurden deutlich verfrüht eingebracht; reife Trauben... blühten in diesem Monat [September] von neuem
- Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: Wohl reift das Korn jetzt sehr schnell
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: [das Ergrünen des Dauergrünlandes] erfolgte im Deutschland-mittel knapp eine Woche früher als üblich; die einzelnen Phasen der phänologischen Entwicklung deutlich früher als im langjährigen Mittel erreicht; die früheste Weinlese aller Zeiten; [Bäumen] das Laub frühzeitig färbte und vorzeitig abgeworfen wurde
 - Jing-Jin-Ji 1997 event: 越冬作物生育期提前; [小麦] 成熟期比常年提早 1-5 天

b) Poor plant growth

Keywords: plant (excl. crops) grew slower than usual, withered/turn yellow/leaves hang limply

- i. Examples of historical sources materials
 - Germany 1834 event: [die Kleeäcker] in einem schlechten Zustand waren
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: Wiesen wurden gelb; [die Blätter] hingen schlaff an den Bäumen
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: die Dürre 2018 und der dadurch abgesenkte Grundwasserspiegel führte bei den Bäumen zu einem Trockenstress
 - Jing-Jin-Ji 1997 event: [牧草] 返青后枯死

c) Plant death

Keywords: plant (excl. crops) died from drought/heat stress

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: insgesamt starben mehr als 300 Millionen Jungpflanzen
 - Jing-Jin-Ji 1997 event: N/A

d) Decreased vegetation cover

Keywords: barren

- i. Examples of historical sources materials
 - Germany 1834 event: die Kleeäcker wie brach dalagen
 - Jing-Jin-Ji 1832 event: 赤地千里
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 赤地千里
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

e) Insect plague

Keywords: grasshoppers/locusts, bark beetles, field mice, etc.

- i. Examples of historical sources materials
 - Germany 1834 event: [Heuschrecken] zur Plage auswuchsen; Feldmäuse hatten sich stark vermehrt
 - Jing-Jin-Ji 1832 event: 虫食禾稼; 菜蔬虫灾; 蝗蝻
- ii. Examples of early modern sources materials
 - Germany 1921 event: Feldmäuse und Fliegen wurden vielerorts zur Plage
 - Jing-Jin-Ji 1920 event: 蝗旱成灾; 飞蝗; 虫灾
- iii. Examples of modern sources materials
 - Germany 2018 event: Trockenheit sorgt für Borkenkäfer-Invasion; regionalen Massenvermehrungen von Feldmäusen
 - Jing-Jin-Ji 1997 event: 夏蝗; 牧区草地螟成虫发生

f) Wildfire

Keywords: fires in forests, scrubs, grasslands, fields, etc.

- i. Examples of historical sources materials
 - Germany 1834 event: die wütenden Wald- und Moorbrände
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: die Waldbrände; ein Feuer 30 Tagwerk Kiefernbestand zerstört
 - Jing-Jin-Ji 1920 event: 麦苗发生火虫, 大半枯槁
- iii. Examples of modern sources materials
 - Germany 2018 event: die Waldbrände; so führte die außergewöhnliche Trockenheit sowohl im Jahr 2018 als auch in diesem Jahr [2019] zu vermehrten Wald- und Flurbränden
 - Jing-Jin-Ji 1997 event: N/A

2) Sub-category of freshwater system

a) Increased water temperature

Keywords: water body was warmed up, raising/abnormal high water temperature

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: der Bodensee hatte sich stark erwärmt
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: sehr hohe Wassertemperaturen; aufgeheizte und austrocknende Gewässer
 - Jing-Jin-Ji 1997 event: N/A

b) Deteriorated water quality

Keywords: algae bloom, increased pollutant concentration, or low oxygen in natural or artificial water bodies

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [der Rhein] Zur Zeit des Niedrigwassers zeigte sich als Folge der Aufkonzentration ein deutlicher Anstieg der Gesamt-Härte, der Chloridkonzentration und der mittels Kaliumpermanganat-Verbrauch gemessenen organischen Belastung.
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: massiven Algenblüten in Seen und Staubecken; [in Bächen] sinken die Sauerstoffgehalte bedenklich ab
 - Jing-Jin-Ji 1997 event: N/A

c) Fish death

Keywords: mass die-off of fish populations due to drought/heat-induced oxygen depletion

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Tonnenweise tote Fische
 - Jing-Jin-Ji 1997 event: N/A

3) Sub-category of soil

Keywords: dust storm, sandstorm

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A

- Jing-Jin-Ji 1920 event: 沙尘遮天匝地
- iii. Examples of modern sources materials
 - Germany 2018 event: Sturmböen sorgen in Hessen für Sandstürme
 - Jing-Jin-Ji 1997 event: 沙尘遮天蔽日; 强沙尘暴席卷

3. Agricultural category

1) Sub-category of soil moisture

Keywords: insufficient soil moisture, cracks in land

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: der Boden ist ganz ausgetrocknet; die Erde rissig
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: die Böden sind trocken; auf leichten Böden wurde das Wasser allmählich knapp
 - Jing-Jin-Ji 1997 event: 土壤失墒严重; 春播白地缺墒; 耕地干裂

2) Sub-category of crop

a) Difficulty in sowing

Keywords: delayed sowing, missed the best time for sowing, unable to sow

- i. Examples of historical sources materials
 - Germany 1834 event: [Regen] kaum die ausgestreute Saat erreichte
 - Jing-Jin-Ji 1832 event: 春麦秋田, 何能播种; 田中晚禾, 只可播种荞麦
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 农田至五月中旬不能播种; 秋禾难下种
- iii. Examples of modern sources materials
 - Germany 2018 event: Winterraps wurde oft sehr spät oder gar nicht erst ausgesät
 - Jing-Jin-Ji 1997 event: 秋季作物的适时播种受到影响; 因旱少播种; 因旱无法播种

b) Growth affected

Keywords: crops were in poor condition, stunted growth, withered

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: 禾苗多枯槁; 其他禾稼, 直至九月尚不尽熟
- ii. Examples of early modern sources materials
 - Germany 1921 event: der Zustand des Gemüses, vor allem der Bohnen, war schlecht; [Kartoffeln] geraten im Wachstum in Stillstand
 - Jing-Jin-Ji 1920 event: 禾苗枯槁
- iii. Examples of modern sources materials
 - Germany 2018 event: der Winterraps lief vielerorts nur langsam und gleichmäßig auf...teils vertrocknete er sogar; schlecht entwickelte Triticalebestände
 - Jing-Jin-Ji 1997 event: 小麦长势不如常年; [作物] 干枯死苗

c) Poor quality

Keywords: grain/potato/etc. quality was poor/lower than usual

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: corn with fifteen or twenty grains to a nubbin...not well formed and were watery; the millet was empty, a mere husk with no head
- iii. Examples of modern sources materials
 - Germany 2018 event: viele kleine Körner und krumme Kolben
 - Jing-Jin-Ji 1997 event: N/A

d) Harvest failure

Keywords: unsatisfactory/poor/bad/destroyed/no harvest

- i. Examples of historical sources materials
 - Germany 1834 event: die Getreide- und Kartoffelernte schlecht; die Ernteaussfälle
 - Jing-Jin-Ji 1832 event: 麦收歉薄; 被旱歉收
- ii. Examples of early modern sources materials
 - Germany 1921 event: die schwere Schädigung der Ernte; der Missernten
 - Jing-Jin-Ji 1920 event: 麦收歉薄; 秋禾歉收; 遍野颗粒不获
- iii. Examples of modern sources materials
 - Germany 2018 event: Ernte fällt noch schlechter aus als erwartet; der Missernten
 - Jing-Jin-Ji 1997 event: 减产; 歉收; 绝收

c) Sub-category of livestock

a) Lack of fodder

Keywords: insufficiency/shortage, increased/expensive prices

- i. Examples of historical sources materials
 - Germany 1834 event: der Futtermangel; der Preis für Heu stieg stark an
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: der Futtermangel; Mangel an Futtermitteln und die Preistreiberei im Verkehr mit Heu
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Futterknappheit wegen Trockenheit; Heu wird momentan gehandelt wie Gold
 - Jing-Jin-Ji 1997 event: 缺草, 缺料

b) Lack of bedding material

Keywords: the need for bedding material (i.e., straw) substitute

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: Torfstreu sollte als Streuersatz besorgt und eingesetzt werden
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

c) Decrease in production

Keywords: livestock products were reduced/lower than usual

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: die Milchanlieferung ist deutlich zurückgegangen
 - Jing-Jin-Ji 1997 event: N/A

d) Death

Keywords: livestock died from drought-induced water shortages/fodder insufficiency/etc.

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A

- Jing-Jin-Ji 1997 event: 牲畜因缺水, 缺草, 缺料而死

4. Hydrological category

1) Sub-category of river

a) Low water level

Keywords: low water level of rivers/streams

- i. Examples of historical sources materials
 - Germany 1834 event: niedrigen Wasserstand; [die Müller] das ganze Jahr nur auf einen Gang mahlen, weil das Wasser so gering war
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: Niedrigwasser
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Niedrigwasser; sinkende Wasserstände in großen Flüssen; die Pegel der großen Flüsse stark gesunken
 - Jing-Jin-Ji 1997 event: 京杭大运河因水位太低, 航运严重受阻

b) Reduced flow

Keywords: low/reduced water flow in streams/rivers

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Bächen mit ohnehin geringer Wasserführung; die geringe Wassermenge, die Ämper und Bäche derzeit mit sich führen
 - Jing-Jin-Ji 1997 event: 主要河道无明显洪峰过程, 基流很小

c) Cutoff

Keywords: streams/rivers dry up,

- i. Examples of historical sources materials
 - Germany 1834 event: Bäche austrockneten
 - Jing-Jin-Ji 1832 event: [河道] 间有全涸处所
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 河水干涸; 河涸
- iii. Examples of modern sources materials
 - Germany 2018 event: trockenen Bachlauf; Teiche und Bäche sind ausgetrocknet
 - Jing-Jin-Ji 1997 event: 河道断流

2) Sub-category of lake & reservoir

a) Shrinking water body

Keywords: pond/lake shrank, pond/lake level dropped

- i. Examples of historical sources materials
 - Germany 1834 event: der Bodensee selbst hat in seiner ganzen Masse und so beträchtlich abgenommen, wie sich dessen Niemand erinnert
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [der Bodensee] der Wasserstand des Sees ging in letzter Zeit täglich mehr zurück
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

b) Decreased water stock

Keywords: reservoir was insufficient filled, reservoir could not maintain required water level

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [Talsperren] nicht ausreichend gefüllt
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: es traten Defizite beim Füllungsgrad von Talsperren; Der Stausee hat zurzeit nur rund ein Viertel seines Wasserstandes
 - Jing-Jin-Ji 1997 event: 水库蓄水不足; [潘家口水库] 库容已经降到历史最低点

c) Dry up

Keywords: pond/lake/reservoir dried up

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 塘淀干涸
- iii. Examples of modern sources materials
 - Germany 2018 event: Teiche und Bäche sind ausgetrocknet
 - Jing-Jin-Ji 1997 event: 塘坝干涸; 水库干涸

3) Sub-category of groundwater

a) Dropped water level

Keywords: wells/springs were running dry, the need for deepening wells, groundwater level dropped

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [die Brunnen] fehlt nicht viel zum Versiegen; mussten Hausbrunnen vertieft werden
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: der Grundwasserpegel geht zurück; den Grundwasserspiegel sinken
 - Jing-Jin-Ji 1997 event: 浅层和深层地下水持续下降; 地下水位下降

b) Insufficiently derfilled aquifer

Keywords: aquifer recharge was inadequate

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: weit weniger gut gefüllt als im vorigen Jahr
 - Jing-Jin-Ji 1997 event: N/A

c) Wells dry up

Keywords: springs/wells dried up

- i. Examples of historical sources materials
 - Germany 1834 event: viele Quellen gänzlich versiegt; die Brunnen waren ausgetrocknet
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: viele Quellen waren nahezu völlig versiegt
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: [private wells, esp.in rural regions] running dry

- Jing-Jin-Ji 1997 event: 大口井, 机井干涸; [机井] 根本抽不出水来

5. Socioeconomic category

1) Sub-category of food security

a) Affordable (price)

Keywords: increased/expensive prices of foodstuffs

- Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: 粮价增昂; 米价昂贵; 一时麦价腾踊, 人皆观望咨嗟
- Examples of early modern sources materials
 - Germany 1921 event: die Brotpreiserhöhung um 40 %; [viele Lebensmittel] verteuerten
 - Jing-Jin-Ji 1920 event: 粮价飞涨; 米价昂; 小米价逾十元, 民难于食
- Examples of modern sources materials
 - Germany 2018 event: teures Obst und Gemüse; Kartoffelpreise mehr als verdoppelt
 - Jing-Jin-Ji 1997 event: N/A

b) Available (supply)

Keywords: difficulty in the processing, preservation, and transportation of foodstuffs, limited supply but not enough to cause famine

- Examples of historical sources materials
 - Germany 1834 event: [die Müller] das ganze Jahr nur auf einen Gang mahlen; [Bachmühlen] standen still
 - Jing-Jin-Ji 1832 event: 日来炎热较甚, 各厂所煮[赈]饭颗, 恐不免有蒸变之虞
- Examples of early modern sources materials
 - Germany 1921 event: die schwierige Ernährungslage; [die Milchversorgung] der Frage der ausreichenden Menge...die geringere Haltbarkeit
 - Jing-Jin-Ji 1920 event: N/A
- Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: 夏荒缺粮

c) Famine

Keywords: famine

- Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: 饥馑; 大饥
- Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 饥荒; 餐餐不给; 饥民遍地
- Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

2) Sub-category of water security

a) Drinking water (supply, quality, price)

Keywords: insufficient/no supply, poor quality, high prices

- Examples of historical sources materials
 - Germany 1834 event: Trinkwasser fehlte; [gutes Wasser] zwei bis drei Kreuzer pro Gelte oder Imi (pro Gelte oder Imi: about 18 liters; daily wage of an industrial worker: 30–60 Kreuzer)
 - Jing-Jin-Ji 1832 event: N/A
- Examples of early modern sources materials
 - Germany 1921 event: die angespannte Trinkwasserversorgung; ohne Wasser
 - Jing-Jin-Ji 1920 event: N/A
- Examples of modern sources materials
 - Germany 2018 event: Trinkwasser aktuell knapp; [Gemeinde] erklärte den Trinkwassernotstand; [emergency supply] partly required until the winter months and did not always have drinking-water quality
 - Jing-Jin-Ji 1997 event: 发生临时性饮水困难; 吃水困难

b) Hygiene and sanitation

Keywords: insufficient/no water for hygiene and sanitation

- i. Examples of historical sources materials
 - Germany 1834 event: Waschen und Putzen war vor allem für die ärmere Bevölkerung nicht zu denken
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [das Waschen der Hände und Füße am Gemeindebrunnen] streng verboten (water was for drinking only due to shortages)
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: ...brach dort die Wasserversorgung zusammen...die Feuerwehr verteilte Brauchwasser für die Toiletten. Pro Person gab es zehn Liter
 - Jing-Jin-Ji 1997 event: N/A

c) Other usage (daily life, agriculture, industry, etc.)

Keywords: limited supply, restricted water usage, high prices

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: das Bewässern von Gärten und landwirtschaftlichen Flächen ebenso verboten wie das Füllen von Schwimmbecken und Autowaschen; [Wäscherei] derzeit liegt der Preis für einen Kubikmeter Frisch- und Abwasser bei rund zehn Euro. Das ist zwei bis beinahe dreimal so viel wie in anderen Städten
 - Jing-Jin-Ji 1997 event: 城市工业, 生活供水和农业菜田用水出现十分严峻的局面; 生活用水困难

3) Sub-category of energy

a) Fuel (cooking, heating, other usage)

Keywords: limited availability, increased price

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: fuel, of course, is scare... the stalks of the kaoliang and millet constitute their fuel...not having had stalks for two years (due to harvest failure)
- iii. Examples of modern sources materials
 - Germany 2018 event: ab Juli 2018 zu einer Frachtverteuerung und einer Steigerung der Benzinpreise
 - Jing-Jin-Ji 1997 event: N/A

b) Electricity (generation, supply, price)

Keywords: decreased generation, limited availability, increased price

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [Wasserkraftwerke] eine reduzierte Energiemenge bereitstellen
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: gleichzeitig führte das Niedrigwasser zu Einschränkungen bei der Stromerzeugung aus Wasserkraft; viele Kraftwerke können wegen der Hitze nicht mit Volllast betrieben werden
 - Jing-Jin-Ji 1997 event: 水电呈大幅下降; 电网的电力供需矛盾突出...不同程度的拉闸限电

4) Sub-category of health

a) Malnutrition and decreased labour capacity

Keywords: weakened by poor access to nutrients

- i. Examples of historical sources materials
 - Germany 1834 event: N/A

- Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: the consequences [eating ground corn cobs, leaves, potato tops, thistles]...first, reduction of efficiency as far as work is concerned, followed by dysentery and ultimately death, either by starvation or disease
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

b) Injury (fire disaster)

Keywords: injured by drought/heat-related fire

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Durch die Dürre breitete sich der Brand in Siegburg rasend schnell aus, zahlreiche Menschen wurden verletzt
 - Jing-Jin-Ji 1997 event: N/A

c) Heat-related illness

Keywords: heatstroke, collapse, heat-induced increases in morbidity

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: je heißer der Sommer, um so größer die Zahl der kranken Säuglinge
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Hitzeschlag; [Kranführer] wegen eines Hitzestaus in seiner Kabine in 25 Metern Höhe kollabiert
 - Jing-Jin-Ji 1997 event: 中暑; 由高温闷热而发生的中暑, 诱发心脑血管病, 肠道疾病急症患者剧增

d) Epidemic

Keywords: epidemic, the sudden appearance and wide spread of a disease

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: 疫; 瘟疫盛行
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 霍乱盛行
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

e) Mental health

Keywords: in desperation, suicide

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 合家投缢自尽
- iii. Examples of modern sources materials
 - Germany 2018 event: N/A
 - Jing-Jin-Ji 1997 event: N/A

f) Death

Keywords: died from starvation /poisoning/coldness/heat stress/etc., increased mortality

- i. Examples of historical sources materials

- Germany 1834 event: N/A
- Jing-Jin-Ji 1832 event: 野多饿殍; 道殍相望
- ii. Examples of early modern sources materials
 - Germany 1921 event: [die drastisch gestiegene Säuglingssterblichkeit] je heißer der Sommer... um so größer die Zahl der Opfer
 - Jing-Jin-Ji 1920 event: 道殍相望; 冻饿过久, 时多僵毙
- iii. Examples of modern sources materials
 - Germany 2018 event: im Zeitraum 2004 bis 2021 war im Jahr 2018 die geschätzte Zahl hitzebedingter Todesfälle in Deutschland am größten; die hohe Zahl heißer Tage im Jahr 2018...mehr hitzebedingte Sterbefälle ermittelt als in den warmen Jahren 2015 und 2019
 - Jing-Jin-Ji 1997 event: 48 小时内, 本市 [天津] 因高温引起死亡的 60 岁以上老人有 50 余名

5) Sub-category of economy

a) Private property losses (fire disaster)

Keywords: fire damage to equipment/shelter/barn/stable/etc.

- i. Examples of historical sources materials
 - Germany 1834 event: [ein verheerenden Feuer] welches bei der großen Dürre... ungeachtet der besten Löschanstalten...An 235 Menschen verloren, mit geringer Ausnahme, ihr Eigentum
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: der Orkan, der die Nacht herrschte, übertrug das Feuer [die Waldbrände] auf die Nachbarorte
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Eine Strohpresse hatte sich entzündet...Die Maschine war erst eineinhalb Jahre alt. Nun müssen wir eine neue Presse kaufen, das kostet uns rund 30.000 Euro
 - Jing-Jin-Ji 1997 event: 家具城发生特大火灾

b) Infrastructure damage

Keywords: water/electricity facilities damaged due to overloading, heat damage to infrastructure

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: Hitze beschädigt Autobahnen
 - Jing-Jin-Ji 1997 event: 持续高温使本市 [天津] 用水量达到高峰...12 处地段自来水管先后出现严重爆裂

c) Decrease in income

Keywords: individual/household/company/etc. reduced due to drought-related damage/shortage/restriction

- i. Examples of historical sources materials
 - Germany 1834 event: ...musste wegen des Futtermangels Vieh notgeschlachtet werden... [der Preis] für Vieh und Fleisch erheblich sank; [Sägemühlen] litten unter den ökonomischen Folgen
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: die Landwirte des Bundeslands [Sachsen-Anhalt] allein beim Roggen in diesem Jahr nur halb so viel einbringen wie im Durchschnitt der vergangenen fünf Jahre
 - Jing-Jin-Ji 1997 event: 冲车业因为用水限令导致营业额大幅下滑; 严重旱灾使一些种粮大户血本无归, 富裕户变成贫困户, 脱贫户变成返贫户

d) Increase in expenditure

Keywords: extra costs due to drought-related damage/shortage/etc.

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A

- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: [extremen Anstieg der Futterkosten] viele Betriebe waren gezwungen, ihre Tierbestände abzubauen oder den Betrieb sogar aufzugeben
 - Jing-Jin-Ji 1997 event: N/A

e) Obstruction of transport

Keywords: increased accidents, limited loads, temporary suspension of traffic

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: [die Schifffahrt] stark eingeschränkt; Schiffe konnten nicht voll beladen werden oder mussten leichtern; [die Zahl der Schiffsunfälle] deutlich erhöht
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: So musste die Frachtschifffahrt an Elbe und Oder vollständig eingestellt werden und an Mosel und Rhein kam es durch Aufleichterungen zu niedrigeren Transportkapazitäten
 - Jing-Jin-Ji 1997 event: 京杭大运河因水位太低, 航运严重受阻

f) Limitations on other economic activities

Keywords: reduced economic activities due to drought-related damage/shortage/etc.

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: N/A
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: auf Grund des niedrigen Pegelstandes des Rheines muss jetzt sogar BASF seine Produktion in Ludwigshafen herunterfahren; (due to low reservoir level) auf dem See musste deshalb eine Segelregatta abgesagt werden, Hoteliers und Gastronomen befürchten großen Schaden für den Tourismus
 - Jing-Jin-Ji 1997 event: N/A

6) Sub-category of social stability

a) Conflict

Keywords: water conflicts, hunger riots

- i. Examples of historical sources materials
 - Germany 1834 event: [die Wasserknappheit] führte zu Konflikten. Müller benötigten das Wasser zum Mahlen, Landwirte wollten ihre Wiesen damit wässern.
 - Jing-Jin-Ji 1832 event: 饥民骚然
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: N/A
- iii. Examples of modern sources materials
 - Germany 2018 event: der Verband Hessischer Fischer hat wegen sommerlicher Niedrigwasserstände vor großem Fischsterben an Wasserkraftwerken gewarnt...warf Kraftwerken die Vernachlässigung ihrer Pflichten aus rücksichtslosem Profitstreben vor...Mehrere Wasserkraftanlagen hatten gegen die Mindestwasser-Regelung geklagt
 - Jing-Jin-Ji 1997 event: 为争水抢水引发的纠纷频频发生

b) Displacement and migration

Keywords: drought-stricken populations left homeland to flee drought-induced hunger/epidemic/etc.

- i. Examples of historical sources materials
 - Germany 1834 event: N/A
 - Jing-Jin-Ji 1832 event: 乏食贫民往往四出就食; 近日京城外来乞食流民成群结队
- ii. Examples of early modern sources materials
 - Germany 1921 event: N/A
 - Jing-Jin-Ji 1920 event: 灾民外出就食者尤伙; 饥民纷纷逃避, 流离四野; [饥民] 沿途乞食, 火车滞行

iii. Examples of modern sources materials

- Germany 2018 event: N/A
- Jing-Jin-Ji 1997 event: N/A

c) Crime

Keywords: profiteering, mobbing, robbery, extortion

i. Examples of historical sources materials

- Germany 1834 event: N/A
- Jing-Jin-Ji 1832 event: 不安本分之徒, 借口灾荒, 强行告贷; 就食饥民有沿村图强抢之; [奸商] 买空卖空, 把持市价

ii. Examples of early modern sources materials

- Germany 1921 event: die spekulativen Aufkäufe [von Frühkartoffeln]
- Jing-Jin-Ji 1920 event: 屡有抢案; in some of the villages it is now dangerous to travel. Robbing is growing constantly

iii. Examples of modern sources materials

- Germany 2018 event: N/A
- Jing-Jin-Ji 1997 event: N/A

d) Moral and ethical collapse

Keywords: sell/abandon/kill family members

i. Examples of historical sources materials

- Germany 1834 event: N/A
- Jing-Jin-Ji 1832 event: N/A

ii. Examples of early modern sources materials

- Germany 1921 event: N/A
- Jing-Jin-Ji 1920 event: 典儿卖女; 鬻女卖儿...襁负不胜, 竟有投诸河者

iii. Examples of modern sources materials

- Germany 2018 event: N/A
- Jing-Jin-Ji 1997 event: N/A